

PNEUMATIC SPRING TERMINOLOGY

Foreword—This Document has not been changed other than to put it into the new SAE Technical Standards Board Format.

1. **Scope**—This pneumatic spring terminology has been developed to assist engineers and designers in the preparation of specifications and descriptive material relating to pneumatic springs and their components. It does not include gas supply or control systems.

2. **References**—There are no referenced publications specified herein.

3. **Pneumatic Spring**—A spring which utilizes the elasticity of a confined gas as the energy medium.

4. General Terms

4.1 **Flexible Member**—The flexible portion of the pneumatic spring.

4.1.1 **BEAD**—That portion of the flexible member adjacent to any attachment part which provides an anchor and a gas seal.

NOTE—The bead can be classified as either mechanically fastened, which produces a seal through a positive clamping medium, or self-sealing, which produces a seal through gas pressure and/or bead displacement.

4.1.2 **REINFORCEMENT**—A structure of cord built into the flexible member to control its shape and strengthen its wall structure against internal gas pressure.

4.1.2.1 **Cord Angle**—The acute angle between a plane through the axial centerline of the flexible member and the centerline of any cord. This angle can pertain to the as-molded shape of the flexible member and will vary according to position of measurement and cross-sectional shape. It also can pertain to inflated shape and will vary according to position of measurement, cross-sectional shape, and inflation pressure.

NOTE—The cord angle is a determining factor of the inflated shape of the flexible member, and may affect the load-deflection characteristics of the assembly. Since it does not totally govern the load-deflection characteristics, cord angle is not usually specified.

4.1.3 **COVER**—The external layer of elastic substance which protects the reinforcement against abrasion, weathering, or other undesirable effects.

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4.1.4 **LINER**—The internal layer of elastic substance which affords resistance to gas permeability and protects the reinforcement against aging or the effects of a harmful environment.

4.2 **Piston (Internal Support)**—The portion of the pneumatic spring which supports the smaller diameter of the flexible member and controls the inward movement of the flexible member during the working stroke, thereby affecting the shape of the load-deflection curve.

4.3 **External Support**—(See Figure 1, A, B, C, D.) A component of some pneumatic springs which controls the outside configuration of the flexible member, thereby affecting the shape of the load-deflection curve. The external support may be either fixed (A, B) or floating (C) in relation to one of the beads.

NOTE— Some pneumatic springs do not employ an external support, but rely on the self-restraining construction of the flexible member (D) to perform the functions of the external support.

5. **Types Of Pneumatic Springs**

5.1 **Piston Type**—This type uses a piston which is attached to the inner bead of a reversible flexible member. See Figure 1.

5.1.1 **REVERSIBLE DIAPHRAGM**—In this type, the piston bead usually passes through the opposite bead of the flexible member. See Figure 1, A and B.

5.1.2 **REVERSIBLE SLEEVE**—In this type, the piston bead travels within the flexible member and does not pass through the opposite bead. See Figure 1, C and D.

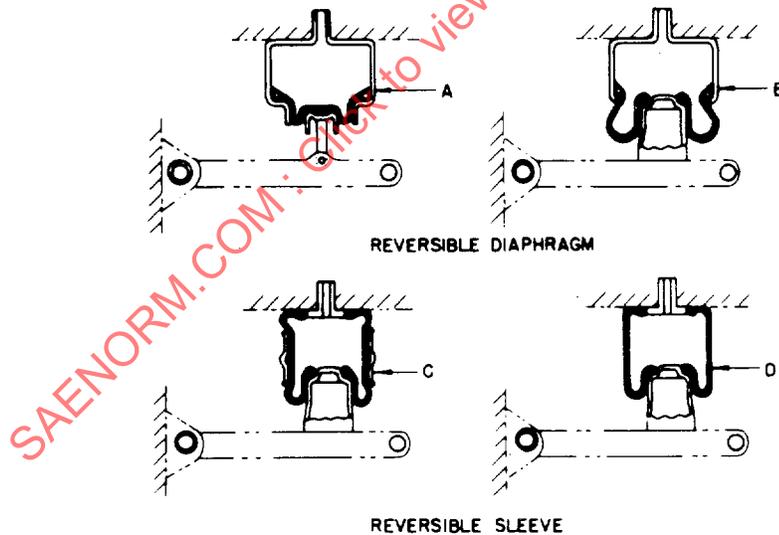


FIGURE 1—PISTON TYPE PNEUMATIC SPRINGS

5.2 **Bellows Type**—This type utilizes a nonreversible flexible member and relies upon its self-restraining characteristics to affect the load-deflection curve. See Figure 2.

NOTE—The flexible member (round or oblong in section) may consist of one or more convolutions. A girdle ring is usually used between the convolutions of the round section multiconvolution bellows type pneumatic spring.

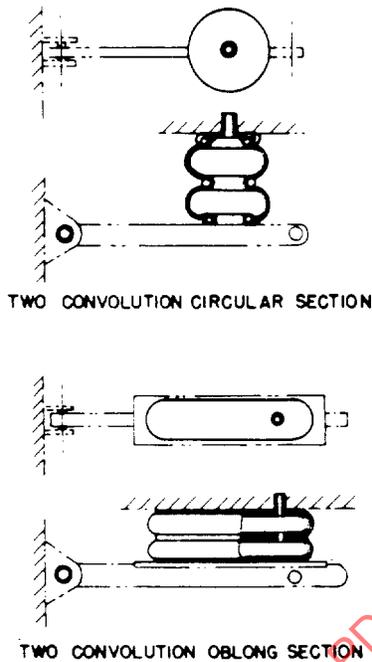


FIGURE 2—BELLOWS TYPE PNEUMATIC SPRINGS

- 5.3 Piston and Cylinder Type**—This type uses a piston and cylinder, but does not require a flexible member. A gas-tight, sliding seal is provided between the piston and cylinder.
- 5.4 Bladder Type**—This type utilizes no integral reinforcement. It relies on being contained with a restrictive structure, such as a coil spring, for its support.
- 5.5 Hydropneumatic Type**—This type contains both liquid and gas. Spring characteristics are provided by the confined gas, while damping may be provided by forcing the liquid through a restriction.
- 6. Pneumatic Spring Characteristics**
- 6.1 Spring Rate**—The change in load per unit of deflection.

NOTE—Figure 3 illustrates a typical load-deflection curve of a pneumatic spring which has a variable effective area versus spring deflection. (Spring supports and cord construction control the degree of variation of the effective area.) With such a pneumatic spring, the rate varies throughout the spring travel. Pneumatic spring rate also varies with the gas compression process, that is, adiabatic, isothermal, or polytropic. However, it is usually specified as the adiabatic rate at the design position.

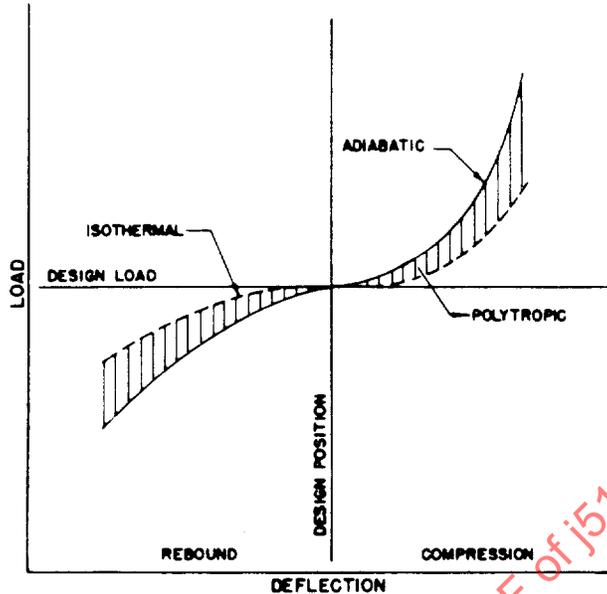


FIGURE 3—PNEUMATIC SPRING LOAD-DEFLECTION CURVE

- 6.1.1 **ADIABATIC RATE**—That rate which results when there is no heat transfer to or from the gas during spring deflection. It is usually approached during rapid spring deflection when there is insufficient time for heat transfer.
- 6.1.2 **ISOTHERMAL RATE**—That rate which results when the spring deflects at a constant gas temperature. Isothermal rate is approached when the spring is deflected very slowly to allow time for the transfer of the heat.
- 6.1.3 **POLYTROPIC RATE**—That rate which results when there is limited heat transfer to or from the gas during spring deflection. Polytropic rate results during spring deflections which produce neither adiabatic nor isothermal rate.
- 6.2 **Working Volume**—The confined gas volume of the pneumatic spring. It is usually specified at design position.
- 6.3 **Design Position**—The selected position of the pneumatic spring which satisfies the vehicle requirements. It is usually specified by a dimension between reference points on the fixed and movable parts of the pneumatic spring.
- 6.4 **Total Spring Travel**—The distance between the extremes of the spring position measured at the spring axis. It is designated as the total of the compression and rebound deflections from the design position.
- 6.5 **Design Load**—The pneumatic spring load at design position.
- 6.6 **Design Pressure**—The internal gas pressure required to support the design load at the design position.
- 6.6.1 **PRESSURE LIMITS**—The minimum and maximum permissible pressures at the design position which provide satisfactory pneumatic spring operation.
- 6.7 **Effective Area**—A nominal area found by dividing the load of the pneumatic spring by its gas pressure at any given spring position.